21st Century Problem Solving Approaches at NASA:
Challenges, Prize Competitions, and Crowdsourcing

NASAfacts

Team Survey accepts a Level One prize during the 2013 Sample Return Robot Centennial Challenge, held at Worcester Polytechnic Institute. Photo credit: NASA

Background

In an increasingly connected and networked world, NASA recognizes the value of the public as a strategic partner in addressing some of the country's most pressing challenges. The agency is working to more effectively harness the expertise, ingenuity, and creativity of individual members of the public by enabling, accelerating, and scaling the use of open innovation approaches including prizes, challenges, and crowdsourcing. NASA recognizes that these methods present an extraordinary opportunity to inspire the development of transformative solutions by offering a means to engage with non-traditional sources of innovative ideas, all in a remarkably cost-effective way.

Why Use Challenges?

Challenges are an important tool for many federal agencies, including NASA. They offer several unique benefits and can result in a variety of valuable outcomes ranging from NASA's own immediate use of the solutions to the development of new viable aerospace industry vendors to the commercialization of new products. The benefits of a challenge approach include:

- **Pay only for success and establish an ambitious goal without having to predict which team or approach is most likely to succeed.** Contracts and grants are awarded based on proposals for future work, forcing agencies to award funds based on past performance and at the expense of innovation. With a focus on proven results, challenges can empower untapped talent to deliver unexpected solutions to tough problems.
- **Inspire risk-taking by offering a level playing field through credible rules and robust judging mechanisms.** Challenges give entrepreneurs and innovators license to pursue an endorsed stretch goal that otherwise would have been considered overly audacious. Clear target metrics and validation protocols defined for the judging of a challenge can themselves become defining tools for the subject industry or field.
- **Reach beyond the "usual suspects" to increase the number of minds tackling a problem.** Challenges are one tool to tap the top talent and best ideas wherever they lie, sourcing breakthroughs from a broad pool of both known and unknown sources of innovation in a given industry.
- **Bring out-of-discipline perspectives to bear.** Empirical research conducted by Harvard Business School finds that breakthrough solutions are most likely to come from outside the scientific discipline or at the intersection of two fields of study.
- **Increase cost-effectiveness to maximize the return on taxpayer dollars.** As teams compete not just for the cash purse, but also for the associated validation, prestige, and satisfaction that result from solving important problems, challenges can incent significant additional investment, leveraging the award's impact.

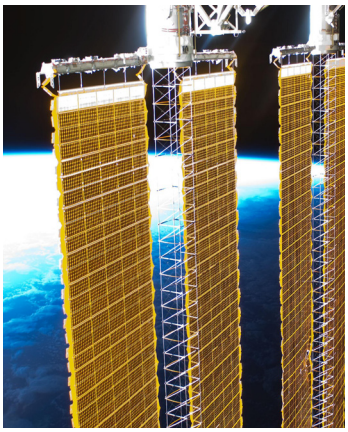
Non-invasive Measurement of Intracranial Pressure

Online Crowdsourcing Challenge: $15,000 Available in Potential Awards

Astronauts who travel in space for extended periods may experience blurred or diminished vision stemming from a flattening of the globe and swelling of the optic nerve due to intracranial pressure. When NASA identified the problem, it immediately established the Intracranial Pressure (ICP) team to work on early diagnosis capabilities and prevention leveraging traditional research tools.

In parallel, NASA's Center of Excellence for Collaborative Innovation issued a series of challenges using several online crowdsourcing platforms seeking a non-invasive method or technology to measure the absolute intracranial pressure. More than 100 responses were received. As a result of the ICP team's infusion of these techniques into their standard research practice, they are expanding their efforts to include the development of two new non-invasive technologies and continuing to investigate other alternatives. The challenge exposed many potentially viable approaches with wide breadth and depth.

Photo above: Using the Advanced Diagnostic Ultrasound in Microgravity (ADUM) protocols, ISS Expedition Commander Leroy Chiao performs an ultrasound examination of the eye on Flight Engineer Salizhan Sharipov. Photo credit: NASA



ISS Longeron Shadowing Challenge

Online Crowdsourcing Challenge: $30,000 Available in Potential Awards

The International Space Station is powered by the sun's energy, which is harnessed through solar panels affixed by a large truss with multiple joints and supported by structures called longerons. The Longeron Challenge asked the community to help identify the most effective positions for the joints on the truss to position the solar panels to generate as much power as possible during the station's most difficult orbital positions while minimizing shadowing effects on the longerons.

At completion, there were 4,056 registered solvers, 459 competitors, and 2,185 submissions – the most popular NASA Tournament Lab challenge to date. In just under two weeks of challenges, the top 10 solutions verified that current NASA implementations are optimized. In addition, several new models were developed that NASA may consider for future use as additional solar array joints degrade.

Photo above: The amount of power generated by each solar panel depends on its orientation with respect to the sun and on any shadows on the solar collectors. NASA provided Longeron Challenge contestants with code to calculate the power generated at a specific orientation. Photo credit: NASA

Power Beaming Centennial Challenge

Technology Development and Demonstration Prize: $2 million in Potential Prize Purse

From 2005-2009, NASA's Centennial Challenges Program and the Spaceward Foundation conducted four power beaming competitions to demonstrate and advance the technology behind the wireless transmission of power. LaserMotive, one of the twelve teams competing, met the Level Two requirements for the challenge and by climbing a 1 km tether at over 3.9 meters per second, won the Level Two prize of $900,000.

The competitors in the challenge demonstrated reliable power beaming at levels that can sustain useful work. After the challenge, LaserMotive and Kansas City Space Pirates continued to advance the technology and provide services for uncrewed aerial vehicle continuous operations, and LaserMotive has advanced the power over fiber optic cable technology.

Photo above: Team E-T-C's climber launches in the 2005 Power Beam competition. Photo credit: NASA

"From the Centennial Challenges Program, to the NASA Open Innovation Pavilion, to the NASA Tournament Lab, NASA is a public-sector leader with breadth and depth of experience and experimentation with prizes and challenges."

– Implementation of Federal Prize Authority: Fiscal Year 2011 Progress Report. OSTP.

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http://www.nasa.gov/content/prizes-and-open-innovation